JC17 Rec'd PCT/PTO 18 MAY 2001

FORM PTO-1390 (REV 10-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (If known, see 37 CFR 1.5)
Az.2673	Not Yet Known 09/856342

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP99/08040	October 22, 1999	November 18, 1998

TITLE OF INVENTION
METHOD OF BURNING A NITROGEN-CONTAINING FUEL

APPLICANT(S) FOR DO/EO/US
HERMANN BRÜGGENDICK AND ANDREAS HOSPITAL

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [X] This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. [X] The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is attached hereto (required only if not communicated by the International Bureau).
   b. [X] has been communicated by the International Bureau.
   c. [ ] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [X] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are attached hereto (required only if not communicated by the International Bureau).
   b. [ ] have been communicated by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 16 below concern document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [X] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [ ] Other items or information:

"Express Mail" Mailing Label Number EL 490 188 872 US
Date of Deposit May 18, 2001

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of patents and trade marks, Washington, D.C. 20231

Mary Ann Copas

Mary Ann Copas, Secretary

JC18 Rec'd PCT/PTO 1 8 MAY 2001

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
Not Yet Known 09/856342	PCT/EP99/08040	Az.2673

	CALCULATIONS PTO USE ONLY	
17. ☒ The following fees are submitted:		
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO **$1000.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO **$860.00**		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO **$710.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) but all claims did not satisfy provisions of PCT Article 33(1)-(4) **$690.00**		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	7 - 20 =	0	X $18.00	$	
Independent claims	1 - 3 =	0	X $80.00	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$860.00	
☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				$	
SUBTOTAL =				$860.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐20 ☐30 months from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED =				$860.00	
				Amount to be refunded:	$
				charged:	$

a. ☒ A check in the amount of $860.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-1653. A duplicate copy of this sheet is enclosed. In the event there is any discrepency in the amount sent herewith or at any time in the future please charge any additional fee, credit or overpayment to the above deposit account number.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

ROBERT W. BECKER & ASSOCIATES
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Robert W. Becker
SIGNATURE:

Robert W. Becker
NAME

26,255
REGISTRATION NUMBER

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Mary Ann Copas, Secretary

In the Application of Dr. Hermann Brüggendick, et al.

Ser.No.: Not Yet Known (based on DE 198 35 162.1 filed 18 November 1998 and PCT/EP99/08040 filed 22 October 1999)

International Filing Date: 22 October 1999

For: METHOD OF BURNING A NITROGEN-CONTAINING FUEL

Assistant Commissioner for Patents
Washington, DC 20231

PRELIMINARY AMENDMENT ACCOMPANYING NATIONAL STAGE APPLICATION

Sir:

Prior to examination, please amend the above-identified application as follows.

IN THE SPECIFICATION:

On page 1, please delete the title "METHOD FOR OPERATING A COMBUSTION PLANT" and insert the following title:

-- METHOD OF BURNING A NITROGEN-CONTAINING FUEL --.

On page 1, immediately after the title, please insert the following heading:

--Background of the Invention--.

On page 4, between lines 5 and 6, please insert the following heading:

--Summary of the Invention--.

On page 7, after line 12, please insert the following paragraphs:

--The specification incorporates by reference the disclosure of German priority

documents 198 53 162.1 of 18 November 1998 and PCT/EP99/08040 of 22 October 1999.

The present invention is, of course, in no way restricted to the specific disclosure of the specification and drawings, but also encompasses any modifications within the scope of the appended claims.--

IN THE CLAIMS:

Please cancel claims 1 - 6, and replace them with the attached claims 7 - 13.

IN THE ABSTRACT:

Please replace the abstract from the cover page of the printed PCT document with the attached Abstract of the Disclosure.

REMARKS

Claims 7 - 13 are pending in the application.

Appropriate headings have been added to the specification, the abstract has been replaced, and the claims from the literal translation have been replaced by claims drafted in conformity with U.S. Patent practice.

The application in its amended state is believed to be in condition for allowance. However, should the Examiner have any comments or suggestions, or wish to discuss the merits of the application, the undersigned would very much appreciate a telephone call in order to be able to expedite placement of the application into condition for allowance.

Respectfully submitted,

Robert W. Becker Reg. No. 26,255
for Applicant(s)

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WHAT IS CLAIMED IS:

7. A method of burning a nitrogen-containing fuel while reducing the emission of nitrogen oxides, said method including the steps of:

producing a sub-stoichiometric primary zone in the form of a flame core, and supplying said flame core with a nitrogen oxide reducing agent, wherein said reducing agent is a nitrogen compound or a hydrocarbon.

8. A method according to claim 7, wherein a temperature of greater than 1100°C is established in said sub-stoichiometric flame core.

9. A method according to claim 7, wherein said sub-stoichiometric flame core is enveloped with a veil of secondary air.

10. A method according to claim 9, wherein said sub-stoichiometric flame core is enveloped with a further veil of tertiary air.

11. A method according to claim 7, wherein said nitrogen oxide reducing agent is introduced into said sub-stoichiometric flame core together with fuel.

12. A method according to claim 7, wherein said nitrogen oxide reducing agent is introduced into said sub-stoichiometric flame core together with primary air.

13. A method according to claim 12, wherein core air is blown into a flame, and wherein said nitrogen oxide reducing agent is

introduced into said sub-stoichiometric flame core together with said core air.

METHOD FOR OPERATING A COMBUSTION PLANT

The present invention relates to a method for operating a combustion plant while reducing the quantity of nitrogen oxides.

Reducing emissions of pollutants when fossil fuels are burned is important in terms of environmental protection. Particularly critical are those pollutants that can neither be filtered out nor washed out. Among these are nitrogen oxides, primarily NO and NO_2. A differentiation should be made between nitrogen oxides that form thermally, that form based on atmospheric nitrogens, and those nitrogen oxides that result from fuel nitrogen. Thermal nitrogen oxides occur largely at temperatures above 1400°C. Their occurrence can be controlled in certain processes by appropriately controlling the temperature. In contrast, nitrogen oxides that are based on fuel nitrogen form even at low combustion temperatures.

The SCR method is primarily used by large-scale commercial plants for reducing emissions of nitrogen oxide. SCR stands for Selective Catalytic Reduction. A reducing agent is added and the spent combustion gas beyond the burnout zone is conducted through a catalytic reactor in which the nitrogen oxides are split up at temperatures of 300 – 400°C and molecular nitrogen is formed. The capital investment required for the catalytic reactor is substantial. In addition, operating costs are high since the catalyzers have to be

cleaned and reconditioned.

Also known is the SNCR method. SNCR stands for Selective Non-Catalytic Reduction. In this method, the reducing agent is introduced directly after the burnout zone into the super-stoichiometric spent combustion gas that is at a higher temperature. The same reactions take place as in the catalytic reactor, but without a catalyzer at a higher temperature and with less of a loss in pressure. A temperature window must be maintained that is between 950 and 1050°C. Above this temperature window there is the risk that the reducing agent will oxidize to nitrogen oxides in the presence of the prevailing excess oxygen. Below this temperature window the desired reactions do not occur on a large enough scale. The reducing agent slips, that is, the reducing agent is carried away by the combustion gas as an ineffective inert. In addition, the efficiency of the SNCR method requires the reducing agent to be mixed very intensively and uniformly, for instance with lances and the like, using a propellant with the spent combustion gas. This method is thus not suitable for large-scale commercial use. Its application is limited to smaller combustion plants, for instance to combined heat and power stations and garbage incineration plants. Large-scale commercial use would require mixing via a cross-section of 100 – 500 m^2 to be performed identically, which is effectively impossible.

The difficulties involved with mixing the reducing agent intensively and uniformly into the stream of combustion gas also have a negative effect on the high-temperature method currently in development. In this case, the reducing agent is introduced into a reduction zone that is situated between the burner zone and the burnout zone. Burner zone and reduction zone are operated sub-stoichiometrically. It can be necessary to work with fuel graduation, that is, to add a residual part of the fuel to the reduction zone. A carrier medium is required for adding the reducing agent. Air is not suitable since the reduction zone must remain sub-stoichiometric. Nitrogen is expensive. That leaves water vapor and liquids that can be evaporated, whereby the efficiency of the process drops in both cases. The same holds true for adding ammonia water, whose evaporating water portion is approximately 75%. In the burnout zone, which is adjacent to the reduction zone, the air factor becomes greater than 1 due to the addition of additional combustion air.

The portion of resultant NO is comparatively low due to the lack of oxygen in the reduction zone. When the reducing agent is added, the NO is split up and molecular nitrogen is formed.

In addition to the problems associated with mixing the reducing agent uniformly and intensively into the reduction zone, there are regulation problems, as well. The burner zone naturally becomes

shorter when there is a change in load. The reduction zone must therefore be moved closer to the burners. When the load is increased, it is necessary to prevent the reduction zone from migrating into the burnout zone and coming into contact there with additional combustion air, which would bring about super-stoichiometric conditions.

The object of the present invention is to provide a method of the type cited in the foregoing that is suitable for large-scale commercial employment in a more efficient and more reliable manner with lower capital and operating costs.

For achieving this object, the method cited in the foregoing is inventively characterized in that a sub-stoichiometric flame zone is produced and in that the nitrogen oxide reducing agent is introduced into the sub-stoichiometric flame zone.

The sub-stoichiometric flame zone has a comparatively small cross-section, so there is no problem distributing the reducing agent uniformly via this cross-section. Changes in load do not affect this, either.

Furthermore, the method in accordance with the invention has none of the temperature limitations that affect the SNCR method. On the contrary, it has proved to be particularly advantageous to adjust the temperature in the sub-stoichiometric flame zone to over 1100°C.

Ammonia is generally selected for the reducing agent; ammonia

water, urea, and other nitrogen compounds can also be used, as well as hydrocarbons, especially natural gas (CH_4). Practically the entire quantity of available oxygen is used for partially oxidizing the carbon in the sub-stoichiometric flame zone. Only a small amount of NO occurs. The presence of the reducing agent ensures that the concentration of the radicals NHi, CHi, and HCN increases. These radicals react with the nitrogen monoxide that has occurred, reduce it, and thus permit molecular nitrogen to occur.

The temperature of the process should preferably be controlled such that upon later burnout, that is, when air is added subsequently, the nitrogen molecules that have occurred (as well as the N_2 molecules in the combustion air) do not break down thermally and form nitrogen oxides. This means that the temperature should not rise above 1400°C.

There is no negative effect if too much reducing agent is employed. Thus, no reducing agent slip can occur because the reducing agent is completely converted during the subsequent burnout when oxygen is added. This means that the residual substances (flue ash and gypsum) can be disposed of with no limitations.

In a substantial further development of the invention, it is suggested that the sub-stoichiometric flame zone be produced as a flame core from fuel and primary air and be enveloped with a veil of

secondary air, preferably also with another veil of tertiary air. The break-down and reduction of the NO thus take place in the sub-stoichiometric flame core. The veils of secondary air, and preferably of tertiary air, then ensure that the fuel burns out and the excess reducing agent breaks down. The combustion gas thus does not come into contact with the surrounding walls when in the sub-stoichiometric state. This effectively prevents the occurrence of high temperature corrosion, which is another major advantage of the present invention.

The nitrogen oxide reducing agent can be introduced into the sub-stoichiometric flame zone through lateral or central lances. However, it is preferably introduced into the sub-stoichiometric flame zone together with the fuel. Furthermore, it can be advantageous to introduce the nitrogen oxide reducing agent into the sub-stoichiometric flame zone together with the primary air. If necessary, the fuel is already mixed with the primary air or a portion of the primary air. In this case the mixture comprises fuel, primary air, and reducing agent.

Furthermore, it is possible to blow into the flame at least a portion of the primary air as core air, whereby this preferably occurs together with the nitrogen oxide reducing agent.

The present invention develops its advantages preferably wherever the fuel has a high nitrogen content. This is the case, for instance, in bituminous coal, tar oil, heavy oil, residual oil, process gas,

and the like. Solid fuels are ground prior to combustion. The reducing agent can be in solid form (also ground) or can also be liquid or gaseous. The method is suitable for all levels of output and works without any additional loss in pressure.

The present invention's main area of application is power plant engineering. The burners are arranged in a plurality of planes one above the other to the side in the boiler wall, whereby the cross-section of the boiler can be 100 – 500 m^2. Air from above is blown in above the uppermost burner plane. Each burner is an independent sub-stoichiometric NO reduction system and delivers super-stoichiometric combustion gases to the boiler. As can be seen, there is no problem with turning individual burner planes on or off.

Patent claims

1. Method for operating a combustion plant while reducing the quantity of nitrogen oxides,

characterized in that

a sub-stoichiometric flame zone is produced and in that a nitrogen oxide reducing agent is introduced into said sub-stoichiometric flame zone.

2. Method in accordance with claim 1, characterized in that the temperature in said sub-stoichiometric flame zone is adjusted to greater than 1100°C.

3. Method in accordance with claim 1 or 2, characterized in that said sub-stoichiometric flame zone is produced as a flame core from fuel and primary air and is enveloped with a veil of secondary air, preferably with another veil of tertiary air.

4. Method in accordance with any of claims 1 through 3, characterized in that said nitrogen oxide reducing agent is introduced into said sub-stoichiometric flame zone together with the fuel.

5. Method in accordance with any of claims 1 through 4, characterized in that said nitrogen oxide reducing agent is introduced into said sub-stoichiometric flame zone together with said primary air.

6. Method in accordance with claim 5, characterized in that core air is blown into said flame and in that said nitrogen oxide reducing

agent is introduced into said sub-stoichiometric flame zone together with said core air.

Abstract of the Disclosure

A method of burning a nitrogen-containing fuel while reducing the emission of nitrogen oxides is provided. A sub-stoichiometric primary zone in the form of a flame core is produced and is supplied with a nitrogen oxide reducing agent that is a nitrogen compound or a hydrocarbon.

09/856,342

Attorney Docket No
Az. ~~2501 (2137)~~ 2673

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:
My residence, post office address and citizenship are as stated below next to my name; I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought of the invention entitled:

METHOD OF BURNING A NITROGEN-CONTAINING FUEL

the specification of which:
____ is attached hereto;
XX was filed on October 22, 1999 as U.S. Application Ser. No. _____, or PCT International Application Number PCT/EP99/08040 AND WAS AMENDED May 18, 2001 US serial number not yet known

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known by me to be material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s):			Priority Claimed:	
			Yes	No
198 53 1621	Germany	18 November 1998	X	—
(Number)	(Country)	(Day/Month/Year Filed)		

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

(Application Number) (Filing Date)

I hereby appoint attorney Robert W. Becker, Reg. No. 26,255, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. Address all telephone calls to (505) 286-3511. Address all correspondence to ROBERT W. BECKER & ASSOCIATES, 11896 N. Highway 14, Suite B, Tijeras, New Mexico 87059.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of first inventor: Dr. Hermann Brüggendick
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Full name of second inventor: Dr. Andreas Hospital
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